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NOTES ON THE HISTORY OF BARRED BREEDS OF POULTRY.¹

RAYMOND PEARL.

At the present time modern breeds of poultry are being much used as material for the study of various problems in genetics. On this account matters connected with the early history of these breeds take on a general biological interest which they would not otherwise possess. It is the purpose of these notes to call attention to certain historical matters which bear directly upon some problems now occupying the writer's attention.

I. THE PRODUCTION OF THE BARRED COLOR PATTERN FROM THE MATING OF SOLID BLACK WITH SOLID WHITE BIRDS.

In an earlier paper² from this laboratory the following statement was made respecting the origin of the barred color pattern, seen now in Barred Plymouth Rock and several other kinds of poultry.

"In regard to the origin of this barred color pattern in poultry very little can be learned. It is known that the Barred Plymouth Rocks owe their barring to the Dominique, which was used in the crossing which led to the production of this breed. But as to the source of the barring in the Dominiques we have found no evidence. Wright (1) says (p. 301) that: 'The colour (barring) itself is not a primary one, but the produce of white with either black or a very dark color. Such colours, mated together, produce as the result, on a wide average of cases, more or less of blacks, whites, mottles or splashes with the plumage of Houdans and Anconas, blues or blue duns like that of blue Langshans and Andalusians, and that bluish barred plumage known as Dominique in America and Cuckoo in England. When once produced, this last colour has however a strong tendency to permanence; and in the common native Dominique fowl of the

¹ Papers from the Biological Laboratory of the Maine Experiment Station, No. 36.

² Pearl, R., and Surface, F. M. "On the Inheritance of the Barred Color Pattern in Poultry." *Arch. für Entwicklungsmech.*, Bd. XXX. (Teil I.), pp. 45-61, 1910.

West Indies and United States it had been preserved and bred so long as to be of a very fixed type indeed, though even in these fowls there was a constant tendency for white or black feathers of the original components to appear, as well as the straw or red which always troubles breeders of white or black fowls.'

"This is the statement of a fancier, made without special study of the inheritance of barring. It is certainly correct in the statement that the barring has become firmly fixed in the Plymouth Rock at least. Such a thing as a completely non-barred bird appearing in any 'pure bred' strain of Barred Plymouth Rocks no longer occurs and has not for a number of years. The statement that the barred pattern originated from a cross between black and white birds, as a sort of intermediate condition, is, we feel certain, a mistake. The barring is a perfectly definite pattern, not simply a mixture of black and white, or a 'splashed' coloration such as is seen in Houdans. The inheritance of barring is of such character as to indicate most strongly that we have to deal here with a unit character, viz., a particular definite and characteristic pattern. Further, so far as we are aware, none of the experiments regarding the inheritance of color in poultry carried out by Bateson, Punnett, Hurst, Davenport¹ or the present writers give the slightest evidence that breeding black and white birds together will produce barred offspring. Finally, in the case of the Plymouth Rocks, where this pattern reaches its most perfect expression, the known history of the breed makes it certain that the barring was not created *de novo*, but was taken from the Dominique."

Since this was written I have found in the literature an interesting piece of definite circumstantial evidence regarding the appearance of the barred pattern in the offspring of a solid black and solid white bird mated together. This would seem at first glance to be clear proof for the *de novo* origin of the pattern. As such it is worth discussing. The case in point concerns the

¹It should have been stated that Davenport (Carnegie Institution, Publication 52, p. 40) has reported barred offspring from crossing a White Leghorn bantam ♂ with a Black Cochin bantam ♀. His results from pure matings, however, show plainly, as he himself states (*loc. cit.*, p. 40 and p. 75), that the White Leghorn stock used carried the barred pattern factor. This case then evidently has no critical bearing on the point under discussion here.

origin of race of bantam fowls known among English fanciers as Cuckoo Pekins. The Cuckoo Pekins were originated about 25 years ago by the well-known English fancier and authority on the bantam breeds, Mr. William Flamank Entwisle. In his book¹ on bantams, which is the standard work on the subject in English, he gives the following statement regarding the appearance of the Cuckoo variety (*loc. cit.*, p. 40).

"We now pass on to the Cuckoo Pekins. These are a very recent introduction; in fact, the first time that a pair of this variety was exhibited was at the Bawtry Show in September, 1888, when Master Frank E. Entwisle exhibited three pairs of them, which produced quite a sensation, one pair winning the silver cup. In colour they are quite as perfect as any shown since, though they are now much improved in shape, cushion, softness of tail, and abundance of foot and shank feather. We first produced Cuckoos in this way: While crossing Black Pekins and White Booted with the double intention of strengthening the Blacks, and producing White Pekins, we reared, amongst others, one a rather dirty looking white, so very excellent in shape, etc., that we thought it good enough to show as White Pekin at the Dairy Show; so we had it caught and washed, but to our surprise it would not come a better white than when first put into the soapsuds; we tried a thorough good soaking, washing, and rinsing, and then had her carefully dried; and on the following morning we had a careful look at her, when we discovered faint but regular bars of stone colour, on a milk white ground. We at once saw that in this pullet we had a more valuable prize than a pure white would have been, and we mated her with her sire, a Black Pekin cock, for the next season. From this mating we had distinct cuckoo markings, and these pullets we mated with a Cuckoo cockerel, which Mr. Leno kindly sent us, and which he bred from his imported Chinese Cuckoo cock, we believe the only one ever sent from China. Then we bred in-and-in, and back to the pure Black Pekins, until they have proved themselves capable of, now and then, beating all other colours of Pekins."

In considering this case the first point to be noted is that there

¹ Entwisle, W. F., "Bantams." Wakefield, 1894 (?), pp. 1-116.

is every reason to suppose that entire reliance may be placed on the statements made, so far as they go. In other words, Mr. Entwisle may be regarded a reliable witness as to the facts. He held a distinguished place among British fanciers, and his book furnishes much evidence that he was a keen and careful observer. Of course, as is usual in such fanciers' reports, critical evidence is lacking at important points in the case here under discussion.

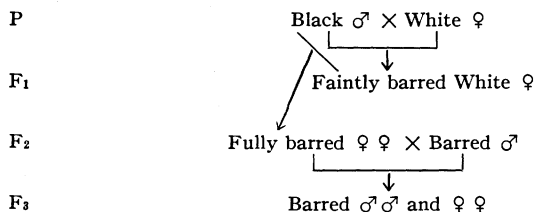
One thing, however, seems clear, namely that while in the particular instance cited, the barred pattern appeared in the F_1 generation from a mating of black by white, it is by no means certain that one or the other of the parents did not carry barring latent (*i. e.*, as a cryptomere). The difficulty in taking this case as proof of the *de novo* origin of the barring lies in the fact that a "Mr. Leno" had at that time a cuckoo cock "imported from China," which evidently carried the barred pattern in hereditary form. If this were the case it is obvious that other color varieties of Asiatic bantams might carry the barred pattern determiner or factor in their gametes, without its being somatically visible. That this is the true explanation of the case is indicated by the fact that in this pullet the *pattern* appeared at once in apparently almost perfect condition ("faint but *regular* bars"). This would scarcely be expected if what is occurring here is the beginning of the synthesis of a barred pattern from pure black and white. Rather one would suppose that at the outstart the barring would be irregular and indefinite in character.

This case described by Entwisle must, then, be regarded as failing to furnish *critical* evidence of the *de novo* origin of the barred pattern in fowls from crossing solid black and solid white.

Incomplete as are the data, however, the case is of interest in another direction. If it be assumed, for the reasons set forth above, that one of the parents of this faintly barred pullet carried the gametic determiner for barring, then one must conclude that it was the White Booted parent. The reasons are, (*a*) that in all cases now known at least (and they cover in published and unpublished work a fair number of different breeds of poultry), if

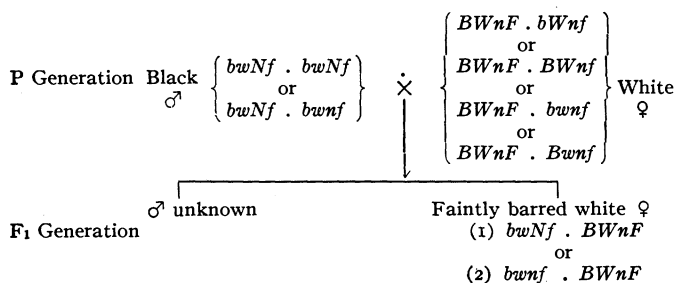
the factor¹ for black pigment and the factor for the barred pattern are present together the zygote will show the barred character. In other words there is no evidence that a black bird can carry barring latent. If such a bird has the barring factor at all it will be visible somatically, so far as present experience goes. (b) The white of the White Booted ♀ parent must have been "dominant white," from the account given. This is indicated by the fact that the prevailing color of the F₁ bird from the cross of this white ♀ with a black ♂ was white. A "dominant white" bird could carry barring gametically for an indefinite period without its showing somatically.

From the data given it is possible to construct the following pedigree.



Now in view of the fact that the barred pattern in all cases so far studied behaves as a sex-correlated character for which the female is heterozygous, this pedigree gives a remarkable result. If the barring was latent in the original White Booted ♀, which seems probable for the reasons set forth above, the observed results *can only be explained on the assumption that the factor for barring and the female sex determiner were carried in the same gamete*. Thus if *B* denotes presence of factor for barred pattern; *W* presence of factor for "dominant white"; *N* presence of factor for black; *F* presence of factor for ♀ sex, and the corresponding small letters the absence of these factors, the pedigree for this black × white cross would stand as follows.

¹ Or factors. Throughout the present discussion it will be assumed for the sake of verbal economy that the characters in each instance depend upon the action of a *single* gametic factor. It makes no difference to the argument whether this is or is not true in a particular instance.



Of these two alternative formulæ in F_1 the first is decidedly the more probable, since there is every reason to expect that (2) would be a pure white bird showing somatically no trace of barring.

In the F_2 generation got by mating the faintly barred white ♀ of F_1 to the black ♂ of the P generation the *females* were barred, indicating again that one of the gametes uniting to form these individuals must have borne both F and B , since no gamete from the sire could bear either of these factors.

It is evident that in interpreting this case we are forced to adopt either one or the other of two alternatives, both of which present novel points in comparison with the results of recent experiments regarding the inheritance of the barred pattern in crosses involving Barred Rocks, in which this pattern is well fixed. On the one hand we may conclude that the White Booted ♀ original parent carried the B factor in its gametes. This interpretation leads to the results worked out above, the novel point in which is that here there is no *repulsion* between B and F in gametogenesis (or *coupling* between B and f if one chooses that view) as is the case in Barred Plymouth Rocks of the present day. Here a non-barred ♂ mated with a female carrying barring (by hypothesis) produces *barred daughters*, where there should be produced (to accord with recent experiments on barring) barred sons and *non-barred* daughters. On the other hand it is possible to assume that the faint barring in the F_1 ♀ arose *de novo*, and that the White Booted ♀ parent did *not* carry the B factor. On this view it must be concluded that *this new character barring when it first appears behaves in an absolutely different way in inheritance from what it does later*. Either conclusion is sufficiently interesting, and stimulating to further research.

Of course a third assumption still is possible, namely that the barring of the Cuckoo Pekins is a different barring entirely from that of Barred Plymouth Rocks, and therefore behaves differently in inheritance. There is no evidence, however, on which to base such an assumption. All of the types of barring which do behave differently in inheritance from the Barred Rock type (*e. g.*, the Campine or the Pencilled Hamburg barring) are somatically distinctly different from the Barred Rock type of

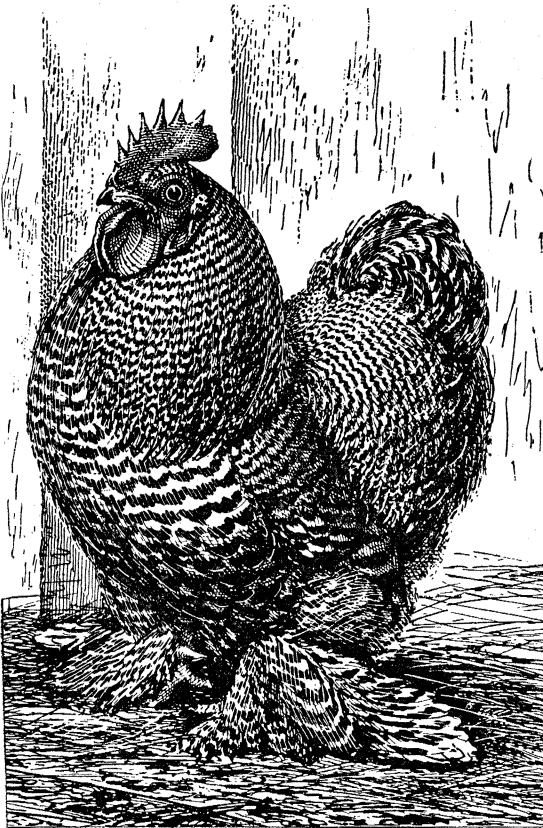


FIG. 1. A Cuckoo Pekin ♂, winner of first and special at Whitby, first and special at Hallam and Ecclesall, etc., etc., 1894. From Entwisle, *loc. cit.*, p. 20.

barring. The barring of the Cuckoo Pekin, however, belongs to the same type somatically. This is shown in Fig. 1, which is a copy of a picture of a Cuckoo Pekin ♂ drawn by the well-known

English poultry artist Ludlow, and published in a plate facing p. 20 of Entwistle's¹ book.

One of the most important and most baffling problems in genetics today is the analysis of "pattern" inheritance. There is definite and indubitable evidence that certain plumage patterns in poultry behave as clean-cut unit characters, dependent on gametic determiners or factors which act precisely like pigment factors for example. Yet the gametic and ontogenetic mechanism of pattern determination and development is most difficult even to imagine. There certainly is great need for further research in this field. Particularly it is important to see whether definite patterns may be formed *de novo* from crosses of birds which bear no trace of the determiners of the patterns gametically.

The case here under discussion illustrates the difficulties which attend the getting of really critical evidence on this matter for the barred color pattern. Merely to show that a black and white bird mated together give barred offspring will not suffice. This happens if one mates any bird carrying black pigment with a White Plymouth Rock, but it is merely (and obviously) because the White Rock carries the barred pattern factor as a cryptomere. To get crucial evidence one must use black and white breeds (*a*) in which there is no evidence of barred birds having been used in the crosses from which the breeds were originated; (*b*) in which there never occur barred "sports"; (*c*) in which barred varieties of the breed are unknown; and (*d*) in which the white of the white parent is a "recessive" and not a "dominant" white. These criteria at once exclude from experiments on synthesizing the barred pattern from black \times white crosses, if such experiments are to be really critical, all Mediterranean breeds (so far at least as these breeds are known to the writer). Further the stock used must be given a thorough preliminary test in Barred Rock crosses to determine whether it does or does not carry the *B* factor. Experience indicates that it is difficult to settle this point if the white of the white race belongs to the "dominant white" category. There are, however, certain races of poultry which seem to fulfil the requirements for a crucial test of the fundamental question of the *de novo* formation of the barred

¹ *Loc. cit.*

pattern from a black \times white cross. Experiments are now being carried on in this direction by the writer.

II. THE COLOR AND PATTERN OF EARLY BARRED PLYMOUTH ROCKS.

The first Barred Plymouth Rock fowls to be entered under this name at a poultry show were exhibited in 1869 by D. A. Upham at Worcester, Mass.¹ They had first been bred some four or five years before that time. So far as I have been able to learn the earliest published picture of fowls of this new breed of fowls, which was in any degree an accurate or adequate representation of the actual birds, first appeared in the *American Agriculturist* in January, 1872.² The well-known poultry artist Mr. Franklane L. Sewell states³ that he knows of no earlier picture than this and his experience in this field is extensive. Whether this picture is absolutely the first of the breed to appear is not essential, nor of any interest other than purely antiquarian. The biological interest of the picture lies first in the fact that it shows the appearance of birds of this breed very early in its history, and second in the fact that the drawing is well done, and may be taken with considerable confidence as an accurate representation of the appearance of the best of the Plymouth Rock fowls of that time. This wood-cut, which is here reproduced as Fig. 2, bore originally the initials, "E. F.," which were those of Edwin Forbes, a rather clever delineator of poultry, who worked in New York.

The picture was copied, or rather apparently printed from the same block, without credit for a prior appearance, and with the artist's initials erased, in the *Poultry World*⁴ for July, 1872. It is from this publication that the picture has been chiefly known to poultry fanciers. Sewell⁵ gives the *Poultry World* as the original place of publication.

¹ Robinson, J. H. "Principles and Practice of Poultry Culture." Boston, 1912, Ginn & Co., p. 399.

² Vol. 31.

³ Sewell, F. L. "Color of Plumage of the Barred Plymouth Rock," *Reliable Poultry Journal*, Vol. XV., p. 520, July, 1908.

⁴ Vol. I., p. 85. This journal which has long since ceased to exist, was published at Hartford, Conn.

⁵ *Loc. cit.*

The drawing was made from actual birds, and is therefore not wholly imaginary or idealistic. The pair of birds figured belonged to a Mr. C. C. Corbett, of Norwich, Conn., and represented a high degree of excellence for the time.

The chief points of interest in this picture for the student of genetics are the relatively dark color of the birds and the indistinctness of the pattern. In both respects, of course, these birds

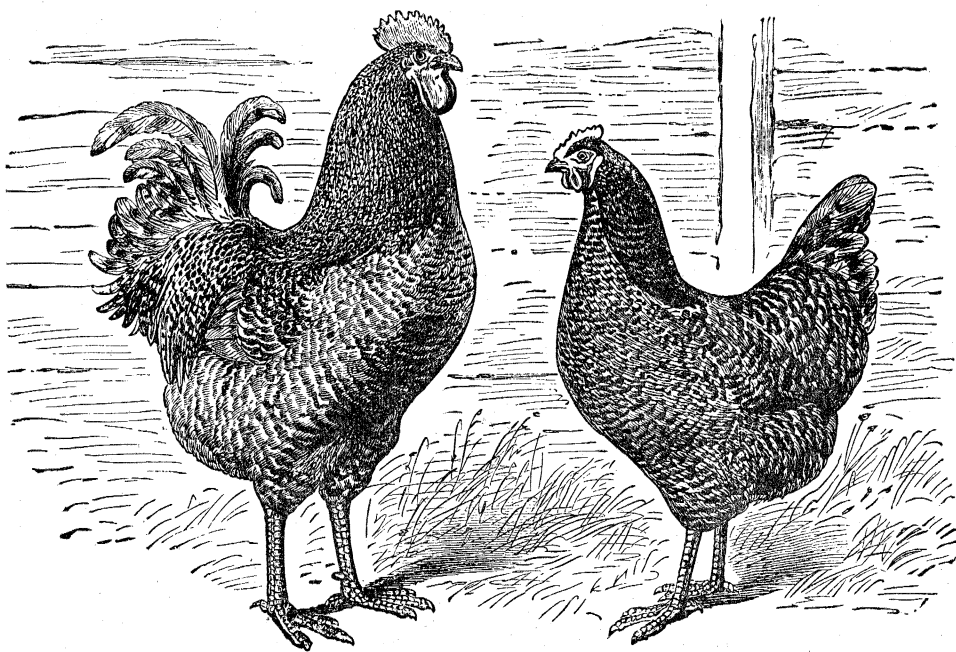


FIG. 2. Plymouth Rock fowls as they appeared in 1872. This is believed to be the earliest adequate picture of birds of this breed.

stand in marked contrast to the Barred Rocks of the present day. While a generally barred effect is evident, the pigment obviously spreads over a great deal of the feather, encroaching on the areas which are white in a modern Barred Rock.

The fact to which I wish especially to call attention is that *these early Plymouth Rocks were evidently very similar indeed in color and color pattern to the F_1 birds obtained by crossing a modern Barred Rock ♂ with a ♀ belonging to some heavily pigmented breed, such as for example the Cornish Indian Game.* Allowing

for differences between modern photographic technique and a wood-cut printed on poor paper, and for differences in shape of body, due to the game blood, the similarity between the birds in Fig. 2 and the barred ♂ and ♀ of the F_1 generation of the cross B. P. R. ♂ \times C. I. G. ♀ published in Roux's Archiv¹ is striking. The male plumage is relatively dark in both cases as compared with that of the modern pure B. P. R. ♂. In the female there is also an excess of pigment, seen not only in the general color tone

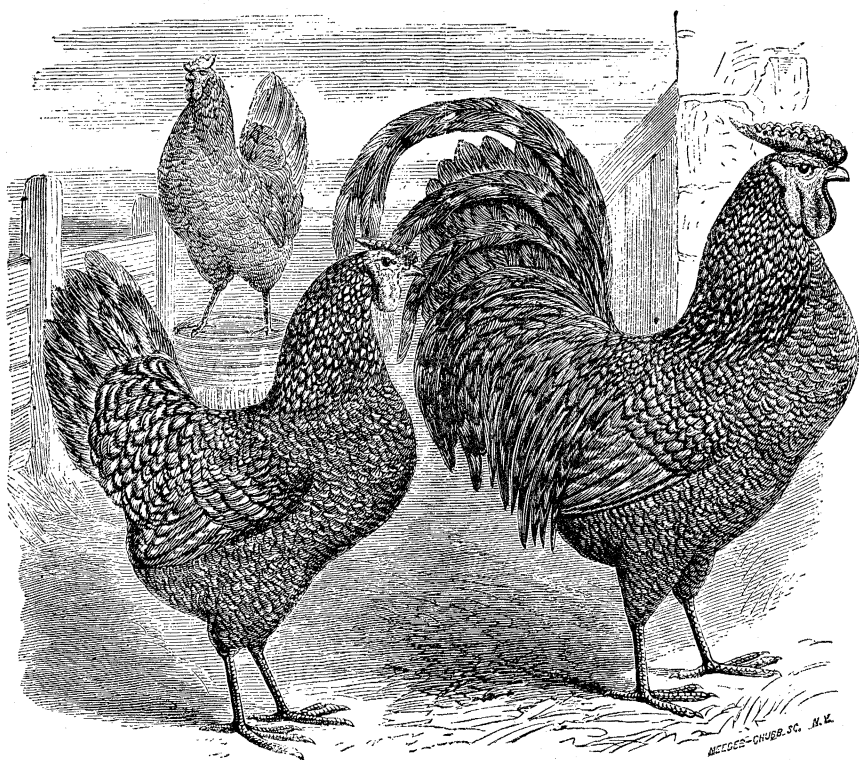


FIG. 3. Reproduction of a wood-cut of Dominiques, originally published in 1870.

of the bird, but in the apparent "smokiness" due to the encroachment of the black bars on to the white areas of the individual feather.

Now in the case of the F_1 birds it is clear what causes (or is at least associated with) the defective development or expression

¹ Pearl and Surface, *loc. cit.*

of the pattern. The pure B. P. R. ♂ of today is, so far as is known, always homozygous with reference to the barring factor, whatever that may be. He carries two "doses" of *B*. Somatically he is light in color with narrow clean cut bars. When by crossing a male is made carrying but one "dose" of *B* (*i. e.*, heterozygous in relation to the barring factor) the somatic pigmentation is markedly changed, and becomes like that of the earliest Barred Rocks known. This obviously suggests that in the early history of the breed the males were regularly heterozygous with reference to barring. If so they should have produced, with considerable regularity, non-barred (black) daughters. As a matter of fact this was probably the case. Up until 20 years ago, and even later in some localities, one would judge from various statements to be found in poultry journals, agricultural papers and the like, that it was not a particularly uncommon occurrence for a Barred Rock mating to throw some solid black chickens.

It is of interest to note that at the time of the original foundation of the Plymouth Rock breed the Dominiques, from which the barred pattern was derived, had the same type of pigmentation. This is shown in a contemporary wood-cut of the latter breed, reproduced in Fig. 3.

This picture of Dominique's was published in the *American Agriculturist*, Vol. 29, p. 13, 1870. It was drawn by Edwin Forbes from a pair of birds owned by Col. Henry Howland of Chicago. These birds were prize winners in their time. This cut, in a very much garbled form, was reproduced in the *Fanciers Journal* in 1876, from which source it has been copied by Sewell.¹

¹ *Loc. cit.*